

* NOTICES *

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CLAIMS

[Claim(s)]

[Claim 1] Mg0.5 - 7.5wt% is contained as an essential element. Further Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of the hide material which the remainder becomes from aluminum to one side or both sides of a core to which the remainder consists of aluminum Fe<=1wt% Si<=1wt% Zn0.1 - 2.5wt%.

[Claim 2] Mg0.5 - 7.5wt% is contained as an essential element. Further Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, Fe<=1wt% is included Si<=1wt%. And Cu0.1 - 1wt%, Mg0.1 - 2wt%, Mn0.1 - 2.5wt%, Cr0.1 - 1.0wt%, The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of one sort or the hide material which two or more sorts are contained selectively and the remainder becomes from aluminum Zr0.1 - 0.3wt% while of nickel0.1 - 1.5wt%.

[Claim 3] Mg0.5 - 7.5wt% is contained as an essential element. And Cu0.01 - 0.5wt%, Two of any, one sort, or Zn0.02 - 2.5wt% of sorts are contained. Furthermore, Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of the hide material which the remainder becomes from aluminum to one side or both sides of a core to which the remainder consists of aluminum Fe<=1wt% Si<=1wt% Zn0.1 - 2.5wt%.

[Claim 4] Mg0.5 - 7.5wt% is contained as an essential element. And Cu0.01 - 0.5wt%, Two of any, one sort, or Zn0.02 - 2.5wt% of sorts are contained. Furthermore, Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, Fe<=1wt% is included Si<=1wt%. And Cu0.1 - 1wt%, Mg0.1 - 2wt%, Mn0.1 - 2.5wt%, Cr0.1 - 1.0wt%, The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of one sort or the hide material which two or more sorts are contained selectively and the remainder becomes from aluminum Zr0.1 - 0.3wt% while of nickel0.1 - 1.5wt%.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is suitable for the product member especially used in oceanic ambient atmospheres, such as a marine vessel, about the aluminum alloy clad plate excellent in the suitable corrosion resistance and the suitable moldability for the ingredient which it is fabricated by elevated-temperature shaping, and surface treatment is performed after that, or is used, without being given.

[0002]

[Description of the Prior Art] After carrying out press forming of the steel plate to hull shell plates, such as a marine vessel, a comparatively small fishing boat, and a leisure boat, especially, it was used in many cases, having performed paint. However, the blemish of paint and the corrosion resistance of a steel plate after exfoliation are low, and since the periodical repaint was required, in recent years, the marine vessel which adopted the hull made from FRP is increasing rapidly. However, since the scrap handling after the life as a ship passes is difficult for the hull made from these FRP, the environmental pollution problem by neglect of **** to the beach etc. is actualizing it.

[0003]

[Problem(s) to be Solved by the Invention] The aluminum plate which is in the above backgrounds, and excels a steel plate in corrosion resistance as hull-construction material of these marine vessels, and excels FRP in scrap handling and the product made from recycle is capturing the spotlight. The alloy of the aluminum-Mg system excellent in corrosion resistance, and reinforcement and a moldability is used for the structural member exposed to such an oceanic ambient atmosphere in many cases. On the other hand, generally a moldability tends to be inferior to a steel plate in aluminum structure material, and it has been a failure at the time of determining the configuration of a product. Then, blue heat forming or elevated-temperature shaping is considered as a technique which fabricates an aluminum plate in a more complicated configuration. This technique is a suitable technique for shaping of the member of which a part or the whole of an ingredient and metal mold is heated at 100-500 degrees C, a fabricating operation is performed on the conditions which raised the moldability of an ingredient, and high processing is required. Furthermore also in this elevated-temperature shaping, bulge forming which uses the usual pneumatics or the fluid pressure other than press working of sheet metal is also considered. According to this approach, in order that a male may become unnecessary in order to use pneumatics or fluid pressure as an application-of-pressure medium, and the ingredient may deform into homogeneity, there is a merit of a shaping limitation improving. However, the black which concentration and oxidation of Mg atom produced on the front face, and green cut when elevated-temperature shaping was performed into the above-mentioned aluminum-Mg system alloy -- presenting -- an exterior -- it is not desirable. Moreover, when painting, in order that this oxidizing zone may reduce paint film adhesion, the corrosion resistance of a product is degraded as a result. Such an oxide film needed to be removed chemically and mechanically and had become the factor which bars productivity. Although generation of this oxide film is influenced by temperature and floor to floor time, it poses a problem especially in press forming or

bulging by the hydraulic press with a comparatively small shaping rate in many cases. This invention develops the corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping suitable for being used in view of these problems to members, such as a shell plate of the comparatively small marine vessel fabricated at an elevated temperature.

[0004]

[Means for Solving the Problem] This invention contains Mg0.5 - 7.5wt% as an essential element. Further Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of the hide material which the remainder becomes from aluminum Fe \leq 1wt% Si \leq 1wt% is made into claim 1. Mg0.5 - 7.5wt% is contained as an essential element. Further Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, Fe \leq 1wt% is included Si \leq 1wt%. And Cu0.1 - 1wt%, Mg0.1 - 2wt%, Mn0.1 - 2.5wt%, Cr0.1 - 1.0wt%, Or two or more sorts are contained selectively. Zr0.1 - 0.3wt%, nickel0.1 - 1.5wt% -- inner -- one sort -- The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of the hide material which the remainder becomes from aluminum is made into claim 2. Mg0.5 - 7.5wt% is contained as an essential element. And Cu0.01 - 0.5wt%, Two of any, one sort, or Zn0.02 - 2.5wt% of sorts are contained. Furthermore, Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, The corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of the hide material which the remainder becomes from aluminum Fe \leq 1wt% Si \leq 1wt% is made into claim 3. Mg0.5 - 7.5wt% is contained as an essential element. And Cu0.01 - 0.5wt%, Two of any, one sort, or Zn0.02 - 2.5wt% of sorts are contained. Furthermore, Cr0.03 - 0.55wt%, Mn0.03 - 2.5wt%, Zr0.03 - 0.25wt%, Ti0.005 - 0.35wt%, Or two or more sorts are contained selectively. Fe0.03 - 0.5wt%, nickel0.03 - 1.5wt% -- inner -- one sort -- To one side or both sides of a core to which the remainder consists of aluminum, Zn0.1 - 2.5wt%, Fe \leq 1wt% is included Si \leq 1wt%. And Cu0.1 - 1wt%, Mg0.1 - 2wt%, Mn0.1 - 2.5wt%, Cr0.1 - 1.0wt%, Zr0.1 - 0.3wt%, while of nickel0.1 - 1.5wt%, let the corrosion-resistant aluminum alloy clad plate for elevated-temperature shaping characterized by carrying out the clad of one sort or the hide material which two or more sorts are contained selectively and the remainder becomes from aluminum be claim 4.

[0005]

[Function] The reason which limited the alloy content in this invention is explained below. The alloy presentation of a core is described first. Mg dissolves in an ingredient and has the effectiveness of raising a moldability, by improving the reinforcement of an ingredient, and ductility. When heated by especially the elevated temperature, there is effectiveness which promotes homogeneous deformation at the time of the fabricating operation of an ingredient, and a shaping limitation improves as the result. Moreover, the static reinforcement as a product is increased, and deformation by the external force is prevented, and a hull etc. is effective in crossing external pressure to long duration and preventing aging (creep deformation etc.) of a carrier beam case. The product which this invention furthermore meant is effective in raising the corrosion resistance of a raw material when a blemish etc. arises in hide material according to an environmental factor etc. If these effectiveness of an addition exceeds 7.5wt% rather than it is enough less than [0.5wt%], in an ingredient, a big and rough aluminum-Mg system compound will be produced, and a moldability and corrosion resistance will be degraded. By producing a detailed compound in an ingredient with Mg, Cu and Zn have the effectiveness of raising a moldability, by improving the reinforcement of an ingredient, and ductility. However, in a product with which both elements tend to reduce the corrosion resistance of a raw material a little, and the corrosion resistance of a core poses a problem, it is desirable to determine addition or additive-free, after taking into

consideration the configuration and operating environment. If an addition can seldom expect, and the improvement effectiveness of a moldability has it for an upper limit below by each minimum and it is added, corrosion resistance will fall remarkably. [good] While Cr, Mn, Zr, Ti, Fe, and nickel produce a detailed compound in an ingredient with aluminum, respectively, make an ingredient organization detailed and raise reinforcement and a moldability, it has the effectiveness of also making the corrosion resistance of a raw material improving. therefore, one sort from the inside of these elements -- or two or more sorts should be added selectively. In the addition of under a minimum, if these effectiveness is added exceeding an upper limit rather than is enough, in an ingredient, a big and rough compound will be produced and a moldability will be degraded, respectively. About content elements other than the above, although it is mainly Si as an impurity element, the lower one of the content is desirable [Si] in order to degrade corrosion resistance while Si produces the compound of a Mg-Si system with Mg at the time of alloy casting, reduces the substantial addition of Mg and reduces the effectiveness. However, since reducing Si content means high grade-ization of an activity metal and this leads to buildup of a manufacturing cost, it is not desirable on industry to reduce Si content beyond the need. From these things, Si content should be made less than [0.5wt%]. About other trace elements, if it is a content not more than 0.05wt%, respectively, an adverse effect will not do to the property of this invention. Therefore, trace elements, such as a misch metal which may be added for improvement in moldabilities, such as Be, B, etc. which may be added for the object, such as a fluidity improvement, can be added in not more than 0.05wt%. Moreover, about an element, if it is a 0.5wt% less or equal, it will not interfere, except that it mixes, in case it manufactures.

[0006] Next, the alloy content of hide material is described. By dissolving and making potential of hide material into **, the potential difference between a core and hide material is enlarged, when it is exposed to corrosive environment as the result at the time of an activity, the precedence corrosion of hide material arises relatively, and Zn does so the effectiveness of improving the corrosion life of the whole member. 0. If in the case of below 1wt% this effectiveness exceeds 2.5 rather than is enough, corrosion resistance will fall remarkably. Although Fe and Si are contained mainly as an impurity, if these elements are contained exceeding 1wt%, respectively, in an ingredient, they will produce a big and rough crystallization object, and will check a moldability and corrosion resistance. Therefore, the content of these elements is made into less than [1wt%]. Cu, Mg, Mn, Cr, Zr, and nickel have the effectiveness of raising the hot moldability of an ingredient. Under at a minimum, when these effectiveness is added exceeding an upper limit rather than is enough, a possibility of reducing a moldability is in reverse, respectively. However, since these elements may reduce corrosion resistance a little in an operating environment, it is necessary to add if needed and they need to determine additive-free. In addition, if the element mixed in the case of manufacture is less than [0.5wt%], it will not have an adverse effect on the property of this invention ingredient. In addition, the clad plate of this invention can be manufactured with a conventional method.

[0007]

[Example] One example of this invention is explained below. The alloy of the core and hide material which have the chemical composition of a table 1 was made into the ingot with 400mm [in thickness], and a width of 2300mm by DC casting. Hide material gave homogenization of 600 degree-Cx8h 5mm of both sides at a time after facing, and made this ingot the 10mm plate with rolling between that post heating, and cold rolling. In the facing back, after giving the ingot, giving 10mm of both sides at a time homogenization of 440 degree-Cx6h+520 degree-Cx8h for hide material as 400 in allmm doubling material, and a core's performing hot rolling and cold rolling with a conventional method after that and using them as a clad plate with a thickness of 1mm, it performed annealing processing of 500 degree-Cx10sec., and made this plate the test specimen. In addition, about the ingredient which does not give a clad among the examples of a comparison, homogenization, hot rolling, cold rolling, and annealing processing were performed for the 380mm ingot after facing like the clad plate, and it considered as the plate for a sample offering with a thickness of 1mm. The 400x400mm test piece was processed from the obtained plate, and the blue-heat-forming punch stretch forming test was presented. The blue-heat-forming punch stretch forming test was fabricated at 450 degrees C using the spherical punch of

200mmphi, and shaping marginal height without crack generating was found. The shaping rate was made into 1mm/sec. with the passing speed of punch. Moreover, the degree of discoloration of the material-list side after shaping was checked by appearance viewing. A result is written together to a table 1. Moreover, after heating 450 degree-Cx5min. as a heating simulation at the time of elevated-temperature shaping and cooling a test specimen in ordinary temperature, the test piece with a width [of 50mm] x die length of 100mm was cut down, and the corrosion test of copper accelerated acetic acid salt spray test 720 hours estimated the corrosion resistance of the field which carries out the seal of one side and has not carried out a seal. The maximum pitting depth of a corrosion test estimated assessment. A result is written together to a table 1.

[0008]

[A table 1]

No		化 学 組 成 (wt%)										張出高さ mm	加熱後の 外観	最大孔食 深さ μm
		Mg	Cu	Zn	Cr	Mn	Zr	Ti	Fe	Ni	Si	Al		
1	心材 皮材	4.5 —	— —	— 1.20	— —	— —	— —	0.001 —	0.02 0.12	— —	0.03 0.09	残 "	変色なし	120
2	心材 皮材	6.2 —	— —	0.29 1.20	— —	— —	0.13 —	0.029 —	0.08 0.12	0.32 —	0.17 0.09	" "	変色なし	118
3	心材 皮材	2.0 1.1	0.35 0.80	— 1.60	0.12 0.18	0.65 0.71	— 0.10	0.022 —	0.18 0.17	— —	0.10 0.11	" "	変色なし	108
4	心材 皮材	5.2 1.20	— —	— 0.80	0.15 —	— 0.34	— 0.12	0.018 —	0.05 0.15	— 1.2	0.06 0.12	" "	変色なし	98
5	心材 皮材	4.9 —	0.42 —	2.1 1.20	0.15 —	— —	0.12 —	0.012 —	0.10 0.12	— —	0.11 0.09	" "	変色なし	112
6	心材 皮材	4.5 —	— —	— —	— —	— —	— —	0.001 —	0.02 —	— —	0.03 —	" "	全面が黒褐色に 変色	280
クラッドなし														
7	心材 皮材	0.2 1.20	0.33 —	2.0 0.80	— —	0.52 0.34	— 0.12	0.010 —	0.18 0.15	— 1.2	0.09 0.12	" "	変色なし	100
8	心材 皮材	9.9 —	— —	— 4.5	— —	— —	— —	0.010 —	0.10 0.12	— —	0.07 0.10	" "	変色なし	290
9	心材 皮材	4.9 2.9	0.42 —	2.1 —	0.15 0.12	— —	0.12 —	0.012 —	0.10 0.14	— —	0.11 0.10	" "	全面が褐色に 変色	320
10	心材 皮材	2.0 —	0.35 —	— 0.05	0.12 —	0.65 —	— 0.19	0.022 —	0.18 1.43	— 1.0	0.10 3.10	" "	変色なし	107

本 発 明 例

比 較 例

[0009] Even if the aluminum alloy clad plate of this invention performs elevated-temperature shaping compared with comparison material, it turns out that the corrosion resistance which excelled after the blue-heat-forming nature which does not have discoloration, either and was excellent, and heating is shown, so that more clearly than a table.

[0010]

[Effect of the Invention] It has the description which shows high reinforcement and corrosion resistance after the outstanding blue-heat-forming workability and processing according to this invention, and does not have nonconformities, such as surface discoloration after processing, etc., and remarkable effectiveness is done so on industry.

[Translation done.]